How Do I Love Thee?
A Biological Perspective

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WHAT IS LOVE?

THE BOND BETWEEN TWO ADULTS?
THE PARENT-CHILD BOND?

'Diego on my mind'

OBSESSION?
What is Love?

attachment
commitment
intimacy
passion & sexual behavior
jealousy
grief upon separation
the domain of poets & artists?

What is Love?
A scientific perspective

An emotion or emotional state?
Consisting of biological processes, &
based on universal needs?

If this is true then we can study
love, as we do other aspects of
biology & behavior
Love - or at least social bonds - are not limited to humans.

Social attachment is a common feature of most definitions of "love".
NO ONE HAS EVER REALLY SEEN A SOCIAL BOND, but....

Social attachments or bonds DO exist and can be studied using measurements of -

BEHAVIOR
ENDOCRINE RESPONSES
AUTONOMIC RESPONSES

Social bonds can be described using...

BEHAVIORAL MEASURES:
Positive interactions
Proximity, especially
SELECTIVE PHYSICAL CONTACT
Abstract concepts like LOVE & SOCIAL BONDS, are most easily understood in the context of their functions which are

SURVIVAL
  social support & safety

REPRODUCTION
  access to mates
  care of offspring
  genetic survival

The most common unit of analysis in biology, and especially in physiology or anatomy is the INDIVIDUAL.
However, it is a biological fact that most living organisms can NOT SURVIVE OR REPRODUCE ALONE.

The mammalian nervous system is designed to work in a SOCIAL environment.

Social behavior is necessary for physiological and behavioral homeostasis.
In the ABSENCE of appropriate social interactions & social bonds (i.e. ISOLATION) - Substitutions May occur

Abuse of Drugs, Food, Mental Dysfunction, ?

For example, following a myocardial infarction, patients with more social support are more likely to survive, possibly because they functionally experience less "stress."

How can a knowledge of the nervous system, and in particular the chemistry of the nervous system give us a deeper understanding of -

THE POWER OF LOVE AND SOCIAL SUPPORT?

THE MECHANISMS THROUGH WHICH BOTH GIVING AND RECEIVING LOVE CAN HEAL?

THE CONSEQUENCES OF LOVE AND BENEVOLENCE ACROSS THE LIFESPAN?

Types of Positive Social Behaviors

Affiliations:
nonselective
may be transient

Social bonds or attachments:
SELECTIVE
LONG-LASTING
What are social bonds??

Hard to define...
but however they are defined
social support and social bonds
are associated with
better mental and physical health

(Uchino, et al., 1996; Singer and Ryff, 2001)

Clues to understanding the biology of
social support and social bonds can come
from asking -

When are social bonds formed?
Pregnancy & Birth

During Lactation & Parental Interactions
In association with Sexual Behavior and perhaps “LOVE”

When there is a need for others or for a Sense of Safety
What are some common features of experiences that facilitate social bonds or lead to "love?"

- "Need states" followed by "need-reduction"
- Possibly feeling that we are "alone?)
- "Stress" or excitement,
  followed by "stress-reduction"
- A sense of "trust," especially during times of danger
- Reduced anxiety or fear of being alone?
- Shared rewarding experiences

DO ALL OF THESE INVOLVE….?
- The release of a brain chemical known as OXYTOCIN??

The human nervous system is a consequence of evolution, with a massive increase in the cerebral cortex.

But, the old parts of the nervous system are still present, and can influence the actions of more modern components. Much of the wiring comes UP from these more primitive brain regions, with fewer pathways that come down. This is why it is hard to use cognition to control emotion.
Studies in rodents leave no doubt that the mechanisms underlying social bonds share neuroendocrine substrates with those for sex, birth, maternal behavior, and lactation, including reliance on a uniquely mammalian hormones including OXYTOCIN.

WHAT IS OXYTOCIN?
Oxytocin is

Made primarily in the brain & Released into the blood supply at the posterior pituitary & also

Released into the brain & spinal cord where it binds to OXYTOCIN receptors OTRs) to influence behavior & physiology.
OXYTOCIN IS RELEASED DURING and FACILITATES

Birth
Lactation
Sexual behavior
Parental behavior
Safe social interactions
  Including nonthreatening touch

Historically lactation was the only viable method for feeding babies

Wet nursing or bottle feeding are alternatives to breast feeding
During the postpartum period modern women may elect to

EITHER LACTATE OR NOT...

The consequences of this decision include changes in the MATERNAL BRAIN and other aspects of maternal physiology and behavior.

Are breast feeding women different? Yes
Lactation has major effects on the Maternal Brain & HPA axis.

Bottle-feeding women have higher levels of NOREPIINEPHRINE.
Bottle-feeding women have higher systolic blood pressure

BLOOD PRESSURE mmHg

Control  Breast  Bottle

n = 14  24  13


Bottle-feeding women have higher basal heart rate

HEART RATE beats/min

Control  Breast  Bottle

n = 14  24  13

Oxytocin increased "Trust" in a computer game... when given intranasally to men.

In this game, the individuals given intranasal OXYTOCIN were twice as likely as those given PLACEBO to give away money.

Kosfeld, Heinrichs, Zak, Fischbacher & Fehr (2005) Nature
However, intranasal oxytocin did improve the ability of men to read the emotions of others from pictures of their eyes.

**Reading the Mind in the Eyes Test (RMET)** (Baron-Cohen et al., 2001 from Domes, Heinrichs, et al., Biol. Psychiatry 2006)

The ability to detect subtle emotional differences was increased in men given intranasal oxytocin.

*Domes, Herpertz, Michel, Berger & Heinrichs Biol. Psychiatry 2006*
As one example, blood levels of oxytocin do increase after massage. However, lying on a massage table also increased oxytocin. There are natural ways to increase the secretion of oxytocin. Perhaps simply feeling “safe” is adequate.

![Oxytocin levels in young human males](image)

*Bello, Carter, et al., unpublished data*

“Do you need others to trust you more? Could you sell more, love more and accomplish more if people trusted you more?

Liquid Trust is the world’s first atmosphere enhancement spray, specially formulated to increase TRUST in YOU. Scientists have recently discovered a chemical that increases levels of trust in people. For the first time, you can have the world in the palm of your hands...it all starts with Trust.”

“Turn The Odds In Your Favor When you spray Liquid Trust on yourself, you become instantly irresistible. We 100% guarantee that Liquid Trust Oxytocin Hormone Spray will enrich your social life or your money back.

*How Should I Use Liquid Trust To ATTRACT WOMEN?* Apply Liquid Trust every morning after showering. Throughout the day, a scentless mist of Oxytocin will be released from you.”
LET THE BUYER BEWARE...

Here is what the Liquid Trust website claims. "Scientists in Switzerland and the United States have found that exposing people to the hormone oxytocin makes them more willing to bond with others." - ABC NEWS June 2, 2005

(This was done in voles, not humans... but... apparently, ABC did not notice.)

Meet more women because they trust you more. Get women who are “out of your league” Increase your social status. Use the power of science. Get Liquid Trust Today!

The World’s FIRST and ONLY product to attract women by getting THEM TO TRUST YOU. Made with pure Oxytocin – A hormone that is scientifically proven to make women trust you more.

But....OXYTOCIN ON THE SKIN WOULD NOT REACH THE BRAIN OF THE USERS OR THE NOSE OF OTHER PEOPLE AT LEVELS CAPABLE OF AFFECTING BEHAVIOR, IN EITHER, SO ANY AFFECT IS PURE PLACEBO.

What are common features of experiences that yield social bonds or a sense of “trust”?

Release of Oxytocin?

“Stress” followed by “stress-reduction”?

NOT, spraying oxytocin on the skin, although changes in the behavior of the wearer might have effects of the behavior others.

Many of these questions, esp at the level of neurobiology can not at present be adequately or ethically studied in humans.
Physiological, especially neurobiological studies are most easily conducted in animals.

What kinds of animals form true social bonds - that is have SELECTIVE social preferences or selective social behavior?

Social bonds are most easily identified and studied in SOCIALLY MONOGAMOUS SPECIES.

But such species are rare in mammals; only 3-5% of mammalian species are described as “monogamous” (Kleiman, 1977).

Particularly helpful to our understanding of social behavior and the social nervous system have been SOCIALLY MONOGAMOUS RODENTS including -

PRAIRIE VOLES, Microtus ochrogaster
PRAIRIE VOLES exhibit selective, and in nature, life-long SOCIAL BONDS:

Both males and females show high levels of infant care
Prairie voles can be studied in nature

And in the Laboratory
Prairie voles have provided experimental evidence for a role for oxytocin in pair bonding, parental care and stress management.

Epidemiological studies suggest that social support is protective against most known emotional and physical disorders (Ryff and Singer, 2001).

What are the mechanisms through which social support might be protective?

One possible protective mechanism is through an enhanced release of oxytocin, which in turn may down-regulate the reactivity of the HPA (stress) responses, including reductions in cortisol (cort).

Relaxing experiences can release oxytocin, and concurrently reduce stress.

Chronic stress also may release oxytocin, possibly helping the individual manage stressful experiences.
OXYTOCIN & BEHAVIOR can be affected by various experiences (to give only a few examples):

- Being in Love
- Being alone, rather than interacting with others (complex?)
- A sense of safety
- Exposure to infants (at least in voles)
- Normal pregnancy and birth
- Decision to breast feed or bottle feed (There is oxytocin in human milk, but not in formula)
- Caesarian section inhibits oxytocin
- Anesthetic drugs inhibit oxytocin
- Exogenous oxytocin ("pitocin") use during birth (complex effects)
- Use of drugs that block oxytocin to prevent premature birth, and so forth

WHAT IS LOVE?

Biology does not have all the answers...
But it does help us to ask new and potentially important questions